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(71)Applicant : VICTOR CO OF JAPAN LTD

(72)Inventor : YAMAMURA TAKASHI
OHARA TERUMI

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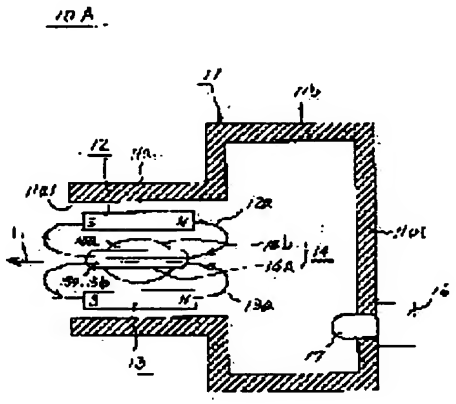
(54) MICROWAVE DISCHARGE LIGHT SOURCE DEVICE AND PICTURE DISPLAY DEVICE USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To enable electron to emit light in a electrode-less lamp with ease.

SOLUTION: The microwave discharge light source device 10 characterized by the construction which comprises a magnetron 16 generating microwave; a resonator 11 with an opening part 11a1 emitting light while making microwave resonate; an electrode-less lamp 14 constructed integrally with first lamp part 14a mounted in the resonator, sealing rare gas 15a and discharging media 15b inside, discharging by dint of the microwave, formed in lengthened shape turning its longitudinal direction toward the opening, and the second lamp part 14b sealing only the rare gas 15a discharging by din of microwave, formed so as to cover the longitudinal peripheral part of the first lamp part, and magnetic force generating means 12, 13 generating lines of magnetic force parallel to the longitudinal direction of the first lamp part of the electrode-less lamp and the direction of the light emitted from the electrode less lamp.



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CLAIMS

[Claim(s)]
[Claim 1] While resonating said microwave with the magnetron which generates microwave The 1st lamp section which enclosed the rare gas and the discharge medium which are formed in the resonator in which opening to which outgoing radiation of the light is carried out was formed, and said resonator, and discharge by said microwave, and formed the longitudinal direction in the long picture toward said opening side, The electrodeless lamp formed in one in the 2nd lamp section which enclosed only the rare gas which discharges by said microwave, and covered the longitudinal direction periphery part of said 1st lamp section, Microwave discharge light equipment characterized by providing a magnetism generating means to generate line of magnetic force parallel to the longitudinal direction of the 1st lamp section of said electrodeless lamp, and the direction of outgoing radiation of the outgoing radiation light from this electrodeless lamp.
[Claim 2] While resonating said microwave with the magnetron which generates microwave The 1st lamp section which enclosed the rare gas and the discharge medium which are formed in the resonator in which opening to which outgoing radiation of the light is carried out was formed, and said resonator, and discharge by said microwave, and formed the longitudinal direction in the long picture toward said opening side, The electrodeless lamp formed in one in the 2nd lamp section which enclosed only the rare gas which discharges by said microwave, and covered the longitudinal direction periphery part of said 1st lamp section, A magnetism generating means to generate line of magnetic force parallel to the longitudinal direction of the 1st lamp section of said electrodeless lamp, and the direction of outgoing radiation of the outgoing radiation light from this electrodeless lamp, Microwave discharge light equipment characterized by providing the loop-formation gap resonator with which it was prepared on the optical axis of the outgoing radiation light from said electrodeless lamp, and electromagnetic-induction nature and electric capacity nature were combined.
[Claim 3] said loop-formation gap resonator -- the shape of approximate circle tubing -- forming -- and the bore of this loop-formation gap resonator -- the diameter of a lamp of the 1st lamp section of said electrodeless lamp -- smallness -- the microwave discharge light equipment according to claim 2 characterized by things.
[Claim 4] Microwave discharge light equipment of claim 1 characterized by carrying out opening of said opening formed in said resonator to an abbreviation vertical to the direction of said line of magnetic force - claim 3 given in any 1 term.
[Claim 5] Said magnetism generating means is microwave discharge light equipment of claim 1 characterized by making it generate said line of magnetic force with a permanent magnet - claim 4 given in any 1 term.
[Claim 6] said magnetism generating means -- electromagnetism -- the microwave discharge light equipment of claim 1 characterized by making it generate said line of magnetic force with a coil - claim 4 given in any 1 term.
[Claim 7] the opening area of said opening formed in said resonator -- the diameter of a lamp of the 1st lamp section of said electrodeless lamp -- smallness -- the microwave discharge light equipment of claim 1 characterized by things thru/or claim 6 given in any 1 term.
[Claim 8] The image display device characterized by using the microwave discharge light equipment of claim 1 thru/or claim 7 given in any 1 term as the light source for projection for image display.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the microwave discharge light equipment which excites the discharge medium in an electrodeless lamp by microwave, and the image display device using this microwave discharge light equipment.
[0002]
[Description of the Prior Art] Conventionally, since it was used as equipment which irradiates large range, such as a lighting system, even when the microwave discharge light equipment without a well-known electrode had the to some extent wide range light-emitting part, it was satisfactory. However, although the need of using microwave discharge light equipment as the light source of an image display device in recent years coming to be considered, and controlling the flux of light by optical system came out, since point-light-source-izing was difficult, the flux of light was not able to be completed and high brightness-ization was not able to be attained. Although preparing a mask with a small opening area in the outgoing radiation light side which carries out outgoing radiation from a lamp as a means to solve this was performed, since the lamp is emitting light uniformly on the whole, it does not pass over the quantity of light which carries out outgoing radiation from opening to the part, but it has become what has very bad effectiveness.
[0003] Moreover, as shown in drawing 11 , the microwave discharge light equipment indicated by JP,7-183008,A is an example using a electron cyclotron resonance of an approach.
[0004] In the microwave discharge light equipment 100 as an example of the conventional example shown in drawing 11 The microwave oscillator 101 which oscillates microwave, and the waveguide 102 to which the microwave oscillated with this microwave oscillator 101 is led, The cylinder-like microwave resonance cavity object 104 with which it connected with this waveguide 102 through the electric supply opening 103, and opening 104a was formed in the front side, The hollow globular form lamp container 105 with which it was prepared in this microwave resonance cavity object 104, and the electroluminescence matter which excites and carries out electroluminescence by microwave was held in that interior, It has the electromagnet or permanent magnet 107 which impresses a magnetic field to this lamp container 105 through a feeder system 106, and is constituted.
[0005] And electric power is supplied to the microwave oscillated from the microwave oscillator 101 in the microwave resonance cavity object 104 from the propagation electric supply opening 103 in a waveguide 102. Since line-of-magnetic-force 107a of the magnetic field by the electromagnet or the permanent magnet 107 has occurred almost in parallel with the travelling direction of microwave when the electroluminescence matter in the lamp container 105 is excited by microwave and carries out electroluminescence by it, Spiral rotation as shown in the electron which exists in the lamp container 105 under the effect of this magnetic field at drawing 12 is made to cause, and the so-called electronic SAIKU roton resonance occurs. Then, outgoing radiation of the light in which only a part to rotate more nearly spirally than the case where the light which carried out electroluminescence within the lamp container 105 does not add a magnetic field became long, and the luminescence pass (distance) and luminescence period of light emitted light is carried out from opening 104a of the microwave resonance cavity object 104.
[0006]
[Problem(s) to be Solved by the Invention] By the way, according to the conventional microwave discharge light equipment 100 shown in drawing 11 Although the luminescence pass and luminescence period of light become long and the opportunity of a part for the electron in the lamp container 105 to rotate to emit light increases, as mentioned above, since the configuration of the lamp container 105 is a hollow globular form-like, While a light-emitting part will become large if the pass of rotation cannot be made to increase but the spherical diameter of the lamp container 105 is enlarged unless the spherical diameter of the lamp container 105 is enlarged, microwave discharge light equipment 100 will also become large-sized.
[0007] Moreover, since the opening area of opening 104a which carried out opening ahead [of the microwave resonance cavity object 104] is also large, when using for an image display device etc., problems, like in the sufficiently small source of luminescence of high brightness, it cannot be using as the point light source have arisen.
[0008]
[Means for Solving the Problem] This invention is made in view of the above-mentioned technical problem. The 1st invention While resonating said microwave with the magnetron which generates microwave The 1st lamp section which enclosed the rare gas and the discharge medium which are formed in the resonator in which opening to which outgoing radiation of the light is carried out was formed, and said resonator, and discharge by said microwave, and formed the longitudinal direction in the long picture toward said opening side, The electrodeless lamp formed in one in the 2nd lamp section which enclosed only the rare gas which discharges by said microwave, and covered the longitudinal direction periphery part of said 1st lamp section, It is microwave discharge light equipment characterized by providing a magnetism generating means to generate line of magnetic force parallel to the longitudinal direction of the 1st lamp section of said electrodeless lamp, and the direction of outgoing radiation of the outgoing radiation light from this electrodeless lamp.
[0009] Moreover, while the 2nd invention resonates said microwave with the magnetron which generates microwave The 1st lamp section which enclosed the rare gas and the discharge medium which are formed in the resonator in which opening to which outgoing radiation of the light is carried out was formed, and said resonator, and discharge by said microwave, and formed the longitudinal direction in the long picture toward said opening side, The electrodeless lamp formed in one in the 2nd lamp section which enclosed only the rare gas which discharges by said microwave, and covered the longitudinal direction periphery part of said 1st lamp section, A magnetism generating means to generate line of magnetic force parallel to the longitudinal direction of the 1st lamp section of said electrodeless lamp, and the direction of outgoing radiation of the outgoing radiation light from this electrodeless lamp, It is microwave discharge light equipment characterized by providing the loop-formation gap resonator with which it was prepared on the optical axis of the outgoing radiation light from said electrodeless lamp, and electromagnetic-induction nature and electric capacity nature were

combined.
[0010] moreover, the microwave discharge light equipment of the 2nd invention which described the 3rd invention above -- setting -- said loop-formation gap resonator -- the shape of approximate circle tubing -- forming -- and the bore of this loop-formation gap resonator -- the diameter of a lamp of the 1st lamp section of said electrodeless lamp -- smallness -- it is characterized by things.
[0011] Moreover, 4th invention is characterized by carrying out opening of said opening formed in said resonator to an abbreviation vertical to the direction of said line of magnetic force in one above-mentioned microwave discharge light equipment of the invention of the 1st - claim 3.
[0012] Moreover, in one microwave discharge light equipment of the invention of the 1st which described the 5th invention above - claim 4, said magnetism generating means is characterized by making it generate said line of magnetic force with a permanent magnet.

[0013] moreover, one microwave discharge light equipment of the invention of the 1st which described the 6th invention above - claim 4 -- setting -- said magnetism generating means -- electromagnetism -- it is characterized by making it generate said line of magnetic force with a coil.
[0014] moreover, the opening area of said opening formed in said resonator in the microwave discharge light equipment of the 1st which described the 7th invention above - the 6th invention either -- the diameter of a lamp of said electrodeless lamp -- smallness -- it is characterized by things.
[0015] Furthermore, the 8th invention is an image display device characterized by using the above-mentioned microwave discharge light equipment of the 1st - the 7th invention either as the light source for projection for image display.
[0016]
[Embodiment of the Invention] One example of the microwave discharge light equipment concerning this invention and the image display device using this microwave discharge light equipment is explained with reference to drawing 1 thru/or drawing 10 below at a detail in order of <the 1st example>, the <2nd example>, and the <3rd example>.
[0017] In the microwave discharge light equipment of the 1st example which showed the sectional view having shown the microwave discharge light equipment of the 1st example which <1st example> drawing 1 requires for this invention, and drawing 2 to drawing 1 Drawing for explaining rotation of the electron generated within the electrodeless lamp under the effect of a magnetic field, the sectional view having shown the 1st modification which deformed drawing 3 for a part of microwave discharge light equipment of the 1st example, and drawing 4 are the sectional views having shown the 2nd modification which transformed a part of microwave discharge light equipment of the 1st example.
[0018] As shown in drawing 1 , at microwave discharge light equipment 10A of the 1st example concerning this invention, the resonator 11 is formed in the shape of a cylindrical shape with a stage by narrow diameter portion 11a and major diameter 11b. In addition, although the resonator 11 is formed in the shape of a cylindrical shape with a stage in the example, without restricting to this, the shape of a mere cylindrical shape has and a cube type-like may be used further. Moreover, the opening 11a1 which carried out opening of the tip is formed in narrow diameter portion 11a of a resonator 11, along with the bore of this narrow diameter portion 11a, the permanent magnets 12 and 13 of falcation [cross section] counter mutually, and pair fixing is carried out. In addition, although it countered mutually and one pair of permanent magnets 12 and 13 are formed in the example, it is larger for effectiveness to have been [either] good and for there to be two or more pairs further, without restricting to this. Moreover, it is also possible to use a doughnut-like (shape of ring) permanent magnet, to replace with a permanent magnet, and to use an electromagnet.
[0019] Moreover, the electrodeless lamp 14 has fixed inside the permanent magnets 12 and 13 of a pair to the opening 11a1 side within narrow diameter portion 11a of a resonator 11. This electrodeless lamp 14 is a thing used as the important section of the 1st example. 1st lamp 14a which enclosed rare-gas 15a and discharge medium 15b which form both ends in the shape of a semi-sphere using transparent quartz glass, and form a longitudinal direction in the shape of [long picture] a cylinder toward an opening 11a1 side, and discharge by microwave inside, It forms in the shape of an ellipse using transparent quartz glass, and is formed in one by 2nd lamp 14b which enclosed only rare-gas 15a which covers the longitudinal direction periphery part of 1st lamp section 14a, and discharges by microwave inside.
[0020] Under the present circumstances, in 1st lamp 14a of an electrodeless lamp 14, metal halogenides, such as a gallium indium thallium, mercury, zinc, sulfur, the selenium, the tellurium, etc. are enclosed as discharge medium 15b which an argon, neon, a xenon, a krypton, etc. are enclosed as rare-gas 15a which discharges by microwave, and discharges by microwave. On the other hand, in 2nd lamp 14b of an electrodeless lamp 14, an argon, neon, the xenon, the krypton, etc. are enclosed as rare-gas 15a which discharges by microwave. And the gas pressure of rare-gas 15a in 2nd lamp 14b and gas volume are set up so that an electrodeless lamp 14 may be mentioned later and outside 2nd lamp 14b can start discharge ahead of inside 1st lamp 14a. Of course, since there is no electrode into 1st and 2nd lamp section 14a of an electrodeless lamp 14, and 14b, reinforcement can be attained. In addition, although the both ends of 1st lamp section 14a of an electrodeless lamp 14 are formed in the shape of a semi-sphere in the example, without restricting to this, both ends may be formed in a flat and the letter of a projection is sufficient as the edge of the direction which is not the outgoing radiation side of light.
[0021] Under the present circumstances, the electrodeless lamp 14 has fixed in narrow diameter portion 11a of a resonator 11 through the permanent magnets 12 and 13 of a pair by filling up with or sintering the dielectric ceramics which is not illustrated between the permanent magnets 12 and 13 of a pair, and an electrodeless lamp 14.
[0022] Moreover, in case the permanent magnets 12 and 13 of a pair are attached in narrow diameter portion 11a of a resonator 11, the south pole and N pole of each magnets 12 and 13 are set up, respectively so that the direction of the line of magnetic force 12a and 13a generated from the permanent magnets 12 and 13 of a pair, respectively may become parallel to the longitudinal direction of 1st lamp section 14a of an electrodeless lamp 14, and the direction of outgoing radiation of the outgoing radiation light L from this electrodeless lamp 14 (the direction of an arrow head).
[0023] Moreover, the magnetron 16 which generates microwave is attached in the outside of the bottom surface part 11b1 of major diameter 11b of a resonator 11. Moreover, the antenna 17 which sends the microwave generated in the magnetron 16 has projected in major diameter 11b of a resonator 11. Electric power is supplied in an electrodeless lamp 14 in the microwave to which the microwave sent from the antenna 17 resonated within major diameter 11b of a resonator 11, and resonated by this.
[0024] And in an electrodeless lamp 14, rare-gas 15a in 2nd lamp section 14b will start discharge first by the microwave which resonated, it will be in the plasma state, and, thereby, the impedance in 2nd lamp section 14b falls. Since it becomes easy to concentrate microwave on 1st lamp section 14a in connection with this Rare-gas 15a in 1st lamp section 14a will discharge, will be in the plasma state, the power included in the electrodeless lamp 14 whole increases, and the temperature of the glass wall of 1st lamp section 14a of an electrodeless lamp 14 rises. The metal in discharge medium 15b enclosed in 1st lamp section 14a evaporates, and it dissociates and condenses in the elevated-temperature section, and becomes a particle, and this particle carries out spectrum luminescence peculiar to a metal with heating of discharge. This particle moves to the low-temperature section in 1st lamp section 14a

of an electrodeless lamp 14, and after metalizing by the reaction with hydrogen and oxygen, it repeats evaporation, dissociation, condensation, and luminescence.
[0025] Since the direction of the line of magnetic force 12a and 13a generated from the permanent magnets 12 and 13 of a pair, respectively is parallel to the longitudinal direction of 1st lamp section 14a of an electrodeless lamp 14, and the direction of outgoing radiation of the outgoing radiation light L from this electrodeless lamp 14 (the direction of an arrow head) here According to the direction of line of magnetic force 12a and 13a Since it rotates spirally between line-of-magnetic-force 12a and 13a as shown in drawing 2 toward the direction of outgoing radiation by the side of opening 11a which the electron which the electron cyclotron resonance happened and was generated in 1st lamp section 14a of an electrodeless lamp 14 formed in narrow diameter portion 11a of a resonator 11 Outgoing radiation of the outgoing radiation light L is carried out from opening 11a formed in narrow diameter portion 11a of a resonator 11. Under the present circumstances, the radius of gyration (Larmor radius) of the electron generated in 1st lamp section 14a of an electrodeless lamp 14 is smaller than diameter of lamp phiD of 1st lamp section 14a of an electrodeless lamp 14 enough. And while being able to lengthen the luminescence pass (distance) and luminescence period of light very much in electronic spiral rotation Distance until an electron collides with the lamp wall of 1st lamp section 14a and loses energy can also be lengthened, and while the electron is exercising freely, the energy of the microwave currently collided and consumed in the lamp wall can be used efficiently.
[0026] moreover, so that flux density is high -- a electron cyclotron resonance -- a lifting -- easy -- since it becomes, by arranging the permanent magnets 12 and 13 of a pair on both sides of an electrodeless lamp 14 so that line of magnetic force parallel to the longitudinal direction of 1st lamp section 14a of an electrodeless lamp 14 may be formed, flux density becomes high and light is strongly emitted near the core of the longitudinal direction of 1st lamp section 14a of an electrodeless lamp 14 to the shape of a cylinder. And the light which emitted light is taken out from the edge of the shape of a semi-sphere of 1st lamp section 14a of an electrodeless lamp 14 as an outgoing radiation light L. carrying out opening of the opening 11a formed in narrow diameter portion 11a of a resonator 11 to an abbreviation vertical here to the direction of line of magnetic force 12a and 13a -- opening 11a -- the flux of light of the outgoing radiation light L -- abbreviation -- the form where a perpendicular cross section is taken -- becoming -- the core of the outgoing radiation light L -- bright -- a facet -- the point light source of a product is acquired.
[0027] Next, the 1st modification which transformed a part of microwave discharge light equipment 10A of the 1st example shown in drawing 1 is explained simple using drawing 3 . In addition, at drawing 3 , while attaching the same code number to the same configuration member as the configuration member of microwave discharge light equipment 10A of the 1st example explained previously, the following explanation explains only a different point from microwave discharge light equipment 10A of the 1st example explained previously.
[0028] As shown in drawing 3 , in microwave discharge light equipment 10B of the 1st modification By attaching the lid 18 which drilled feed-hole 18a of 1mm or less of abbreviation in the opening 11a1 which carried out opening for the diameter sufficiently smaller than diameter of lamp phiD of 1st lamp section 14a of an electrodeless lamp 14 at the tip of narrow diameter portion 11a of a resonator 11 The outgoing radiation light L which carried out outgoing radiation is obtained from this feed-hole 18a as the clearer point light source, and the opening area of feed-hole 18a can take out the outgoing radiation light L efficiently as it is small. Moreover, a metallic material is used or the effectiveness of preventing the leakage to the exterior of microwave by using for the lid 18 which drilled feed-hole 18a combining a wire gauze and a protection-from-light member is acquired.
[0029] Next, the 2nd modification which transformed a part of microwave discharge light equipment 10A of the 1st example shown in drawing 1 or microwave discharge light equipment 10B of the 1st modification is explained simple using drawing 4 . In addition, at drawing 4 , while attaching the same code number to the same configuration member as the configuration member of the microwave discharge light equipment 10A and 10B explained previously, the following explanation explains only a different point from the microwave discharge light equipment 10A and 10B explained previously. Moreover, what is necessary is just to attach a lid 18 if needed in the 2nd modification, although the lid 18 which drilled feed-hole 18a of 1mm or less of abbreviation at the tip of narrow diameter portion 11a of a resonator 11 is attached in drawing 4 .
[0030] Here, in microwave discharge light equipment 10A of the 1st above mentioned example, or microwave discharge light equipment 10B of the 1st modification, since the temperature of an electrodeless lamp 14 becomes 500 degrees [of abbreviation] C-1000-degreeC, and an elevated temperature by microwave, intensity of magnetization will reduce extremely the permanent magnets 12 and 13 of the pair prepared in narrow diameter portion 11a of a resonator 11 according to the high temperature from an electrodeless lamp 14. Of course, even when an electromagnet is used without using permanent magnets 12 and 13, it demagnetizes like the above.
[0031] Then, the outside of narrow diameter portion 11a of a resonator 11 is made to carry out pair maintenance of the falcation permanent magnets 12 and 13 in microwave discharge light equipment 10C of the 2nd modification using the attachment component which counters mutually and is not illustrated, as shown in drawing 4 . In addition, although the permanent magnets 12 and 13 of a pair were made to counter mutually and are prepared also in the 2nd modification, it is larger for effectiveness to have been [either] good and for there to be two or more pairs further, without restricting to this. Moreover, it is also possible to use a doughnut-like (shape of ring) permanent magnet, to replace with a permanent magnet, and to use an electromagnet.
[0032] Here, in case the permanent magnets 12 and 13 of a pair are formed in the outside of narrow diameter portion 11a of a resonator 11, at least, the narrow diameter portion 11a part of a resonator 11 is forming using the mesh ingredient which uses and forms the small ingredient of relative permeability, or has conductivity, can reduce the effect of the high temperature from an electrodeless lamp 14, and can centralize line of magnetic force 12a and 13a.
[0033] Microwave discharge light equipment 10A (or 10B or 10C) by the above-mentioned configuration Rare-gas 15a and discharge medium 15b are enclosed with 1st lamp section 14a of the inside which can attain reinforcement with an electrodeless lamp 14, and constitutes an electrodeless lamp 14. By enclosing only rare-gas 15a with 2nd lamp section 14b of the outside which constitutes an electrodeless lamp 14 First, since rare-gas 15a in 2nd lamp section 14b will start discharge by the microwave which resonated, it will be in the plasma state and the impedance in 2nd lamp section 14b falls by this In connection with this, it becomes easy to concentrate microwave on 1st lamp section 14a, an electron becomes easy to emit light within 1st lamp section 14a, and spectrum luminescence peculiar to a metal can be carried out. By moreover, the thing for which the line of magnetic force 12a and 13a parallel to the longitudinal direction of 1st lamp section 14a of an electrodeless lamp 14 and the direction of outgoing radiation of the outgoing radiation light L from this electrodeless lamp 14 is given to an electrodeless lamp 14, and the luminescence pass (distance) and luminescence period of light are lengthened By gathering and forming discharge effectiveness into high brightness to the direction of outgoing radiation of the outgoing radiation light L, and carrying out outgoing radiation of the outgoing radiation light L from a small area, the outgoing radiation light L from an electrodeless lamp 14 can be used as the point light source.
[0034] The sectional view having shown the microwave discharge light equipment of the 2nd example which <2nd example> drawing 5 requires for this invention, the sectional view having shown the 1st modification which deformed drawing 6 for a part of microwave discharge light equipment of the 2nd example, the sectional view having shown the 2nd modification which deformed drawing 7 for a

part of microwave discharge light equipment of the 2nd example, and drawing 8 are the perspective views having expanded and shown the loop-formation gap resonator in the microwave-discharge light equipment shown in drawing 5 - drawing 7 .
[0035] Microwave discharge light equipment 20C of the 2nd modification which transformed a part of 2nd example shown in drawing 7 into the microwave discharge light equipment 20B list of the 1st modification which transformed a part of 2nd example shown in microwave discharge light equipment 20A of the 2nd example and drawing 6 concerning this invention shown in drawing 5 There is correspondence relation to the microwave discharge light equipment 10A, 10B, and 10C in the 1st example explained previously, respectively, and here attaches and explains a new code number only about a different point from the microwave discharge light equipment 10A, 10B, and 10C in the 1st example.
[0036] In microwave discharge light equipment 20A (or 20B or 20B) shown in drawing 5 (or drawing 6 or drawing 7), the loop-formation gap resonator 21 of the shape of a tube used as the important section of the 2nd example is formed on the optical axis K of this lamp 14 by the outgoing radiation side of the light of the electrodeless lamp 14 formed in narrow diameter portion 11a of a resonator 11. Under the present circumstances, by doubling the medial axis of the loop-formation gap resonator 21 with the optical axis K of an electrodeless lamp 14, while the direction of a medial axis of the loop-formation gap resonator 21 becomes parallel to the direction of outgoing radiation of the outgoing radiation light L from an electrodeless lamp 14 (the direction of an arrow head), to the optical axis K of an electrodeless lamp 14, the loop-formation gap resonator 21 carries out an abbreviation rectangular cross, and is formed. In addition, in the example, although the loop-formation gap resonator 21 is formed in the outgoing radiation side of the light of an electrodeless lamp 14, you may prepare in the both ends of an electrodeless lamp 14.
[0037] Moreover, the loop-formation gap resonator 21 serves as structure which has the same resonance frequency as a resonator 11 united with a resonator 11 by being filled up with the dielectric ceramics which is not illustrated between the periphery part of the tube-like loop-formation gap resonator 21, and the periphery part of an electrodeless lamp 14 and/or the inner circumference part of the permanent magnets 12 and 13 of a pair. Moreover, the structure gestalt which has electromagnetic-induction nature and electric capacity nature so that it may mention later is used for the loop-formation gap resonator 21.
[0038] That is, as it expands to drawing 8 and was shown, the loop-formation gap resonator 21 consists of resonance ring part 21a of the shape of approximate circle tubing which consists of conductive ingredients, such as copper, aluminum, and silver, and gap section 21b which cut and lacked a part of this resonance ring part 21a by thin width of face, and bore phid of resonance ring part 21a is formed smaller than diameter of lamp phiD of the 1st lamp section 14 of an electrodeless lamp 14. In addition, although one gap section 21b was formed in tube-like resonance ring part 21a in the example, it is also possible to make it the shape of a loop formation electromagnetic by forming two or more gap section 21b in tube-like resonance ring part 21a, and filling up with and holding the dielectric ceramics to each gap section 21b, without restricting to this.
[0039] Here, since resonance ring part 21a has electromagnetic-induction nature when the direction of a medial axis of the loop-formation gap resonator 21 is arranged so that it may become the direction of the magnetic flux of fluctuation electromagnetic field, and parallel, spiral induced potential arises in a circumferencial direction, electric field are generated in gap section 21b by this, and it has electric capacity nature.
[0040] Therefore, at microwave discharge light equipment 20A (or 20B or 20C), the outgoing radiation light L from an electrodeless lamp 14 can be used as the point light source by drawing the energy of microwave in an electrodeless lamp 14 efficiently with the loop-formation gap resonator 21, gathering and forming discharge effectiveness into high brightness to the direction of outgoing radiation of the outgoing radiation light L of an electrodeless lamp 14, and carrying out outgoing radiation of the outgoing radiation light L from a small area.
[0041] The block diagram having shown the case of a transparency mold as an image display device using the microwave discharge light equipment which <3rd example> drawing 9 requires for this invention, and drawing 10 are the block diagrams having shown the case of a reflective mold as an image display device using the microwave discharge light equipment concerning this invention.
[0042] First, as shown in drawing 9 , the outgoing radiation light L which carried out outgoing radiation from the electrodeless lamp 14 which constitutes the microwave discharge light equipment 10A-10C (or 20A-20C) in the 1st example (or the 2nd example) which explained the image display device 30 of a transparency mold previously is irradiated by the transparency mold liquid crystal plate 32 with a lens 31. This transparency mold liquid crystal plate 32 displays a desired image with the picture signal from the liquid crystal drive circuit 33. The image light G which penetrated the transparency mold liquid crystal plate 32 is expanded with a projector lens 34, and expansion projection is carried out on a screen 35.
[0043] By therefore, the thing which discharge effectiveness is gathered and formed into high brightness to the direction of outgoing radiation of the outgoing radiation light L of an electrodeless lamp 14 using the microwave discharge light equipment 10A-10C (or 20A-20C) explained previously, and is done for the outgoing radiation of the outgoing radiation light L from a small area Since the outgoing radiation light L from an electrodeless lamp 14 can be used as the point light source, it is a low power as the light source for projection of the image display device 30 of a transparency mold, and the expansion projection of the image can be carried out at high brightness / high definition / high definition.
[0044] Next, as shown in drawing 10 , the light W write-in [the image display device 40 of a reflective mold / according to a picture signal] to one field 41a of the optical address type space modulation element 41 is irradiated, optical information is written in, and this optical information is amplified inside.
[0045] The outgoing radiation light L which carried out outgoing radiation from the electrodeless lamp 14 which, on the other hand, constitutes the microwave discharge light equipment 10A-10C (or 20A-20C) in the 1st example (or the 2nd example) explained previously Incidence is carried out to the polarization beam splitter 45 through an infrared cut filter 42, a lens 43, and the wavelength filter 44. It is reflected by transflective reflective film 45a of the polarization beam splitter 45, and the reflected light is irradiated by field 41b of another side of the optical address type space modulation element 41, and is reflected as a read-out light R which contained image information by field 41b of this another side. Then, the read-out light R containing image information penetrates transflective reflective film 45a of the polarization beam splitter 45, is expanded with a projector lens 46, and expansion projection is carried out on a screen 47.
[0046] By therefore, the thing which discharge effectiveness is gathered and formed into high brightness to the direction of outgoing radiation of the outgoing radiation light L of an electrodeless lamp 14 using the microwave discharge light equipment 10A-10C (or 20A-20C) explained previously, and is done for the outgoing radiation of the outgoing radiation light L from a small area Since the outgoing radiation light L from an electrodeless lamp 14 can be used as the point light source, it is a low power as the light source for projection of the image display device 40 of a reflective mold, and the expansion projection of the image can be carried out at high brightness / high definition / high definition.
[0047]
[Effect of the Invention] In the microwave discharge light equipment concerning this invention concerning this invention explained in full detail above According to the claim 1 publication, reinforcement can be attained with an electrodeless lamp. By enclosing rare gas

and a discharge medium with the 1st lamp section of the inside which constitutes an electrodeless lamp, and enclosing only rare gas with the 2nd lamp section of the outside which constitutes an electrodeless lamp First, since the rare gas of the 2nd lamp circles will start discharge by the microwave which resonated, it will be in the plasma state and the impedance of the 2nd lamp circles falls by this In connection with this, it becomes easy to concentrate microwave on the 1st lamp section, an electron becomes easy to emit light in the 1st lamp department, and spectrum luminescence peculiar to a metal can be carried out. Moreover, the outgoing radiation light from an electrodeless lamp can be used as the point light source by gathering and forming discharge effectiveness into high brightness to the direction of outgoing radiation of outgoing radiation light by giving line of magnetic force parallel to the 1st lamp section of an electrodeless lamp, and the direction of outgoing radiation of the outgoing radiation light from this electrodeless lamp to an electrodeless lamp, and lengthening the luminescence pass (distance) and luminescence period of light, and carrying out outgoing radiation of the outgoing radiation light from a small area.

[0048] Moreover, according to the claim 2 publication, while the same effectiveness as claim 1 publication is acquired, the outgoing radiation light from an electrodeless lamp can be used as the point light source by drawing the energy of microwave in an electrodeless lamp efficiently with a loop-formation gap resonator, gathering and forming discharge effectiveness into high brightness to the direction of outgoing radiation of the outgoing radiation light of an electrodeless lamp further, and carrying out outgoing radiation of the outgoing radiation light from a small area.

[0049] Moreover, since the point light source by the engine performance of the above-mentioned electrodeless lamp is used as the light source for projection for image display according to the image display device using the microwave discharge light equipment concerning this invention, it can contribute to the low power of an image display device, and the expansion projection of the image can be carried out with microwave discharge light equipment at high brightness / high definition / high definition.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view having shown the microwave discharge light equipment of the 1st example concerning this invention.
[Drawing 2] In the microwave discharge light equipment of the 1st example shown in drawing 1 , it is drawing for explaining rotation of the electron generated within the electrodeless lamp under the effect of a magnetic field.
[Drawing 3] It is the sectional view having shown the 1st modification which transformed a part of microwave discharge light equipment of the 1st example.
[Drawing 4] It is the sectional view having shown the 2nd modification which transformed a part of microwave discharge light equipment of the 1st example.
[Drawing 5] It is the sectional view having shown the microwave discharge light equipment of the 2nd example concerning this invention.
[Drawing 6] It is the sectional view having shown the 1st modification which transformed a part of microwave discharge light equipment of the 2nd example.
[Drawing 7] It is the sectional view having shown the 2nd modification which transformed a part of microwave discharge light equipment of the 2nd example.
[Drawing 8] In the microwave discharge light equipment shown in drawing 5 - drawing 7 , it is the perspective view having expanded and shown the loop-formation gap resonator.
[Drawing 9] It is the block diagram having shown the case of a transparency mold as an image display device using the microwave discharge light equipment concerning this invention.
[Drawing 10] It is the block diagram having shown the case of a reflective mold as an image display device using the microwave discharge light equipment concerning this invention.
[Drawing 11] It is the block diagram having shown microwave discharge light equipment as an example of the conventional example.
[Drawing 12] In the microwave discharge light equipment shown in drawing 12 , it is drawing for explaining rotation of the electron which exists in a lamp container under the effect of a magnetic field.
[Description of Notations]
10A -- The microwave discharge light equipment of the 1st example concerning this invention, 10B -- Microwave discharge light equipment of the 1st modification which transformed a part of 1st example, 10C -- Microwave discharge light equipment of the 2nd modification which transformed a part of 1st example, 11 [-- Major diameter,] -- Resonators 11 and 11a -- A narrow diameter portion, 11a1 -- Opening, 11b 12 13 -- A permanent magnet, 12a, 13a -- Line of magnetic force, 14 -- Electrodeless lamp, 14a [-- Discharge medium,] -- The 1st lamp section, 14b -- The 2nd lamp section, 15a -- Rare gas, 15b 16 [-- Microwave discharge light equipment of the 2nd example concerning this invention,] -- A magnetron, 18 -- A lid, 18a -- A feed hole, 20A 20B -- Microwave discharge light equipment of the 1st modification which transformed a part of 2nd example, 20C -- Microwave discharge light equipment of the 2nd modification which transformed a part of 2nd example, 21 [-- Hikaru Idei.] -- A loop-formation gap resonator, 30 -- The image display device of the transparency mold using the microwave discharge light equipment concerning this invention, 40 -- The image display device of the reflective mold using the microwave discharge light equipment concerning this invention, L

[Translation done.]

* NOTICES *

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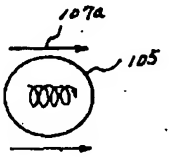
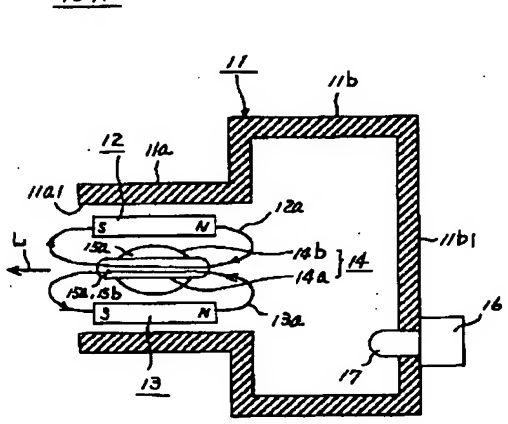
DRAWINGS

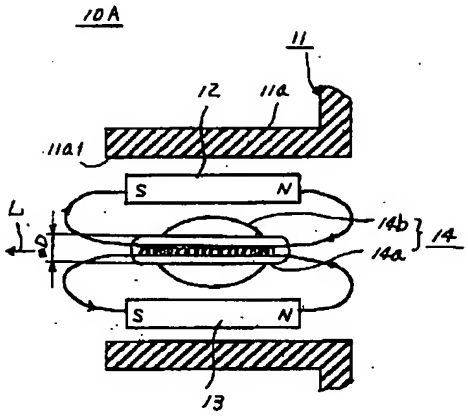
[Drawing 12]



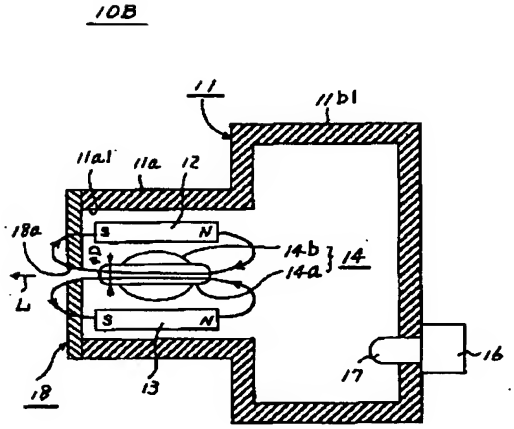
[Drawing 1]



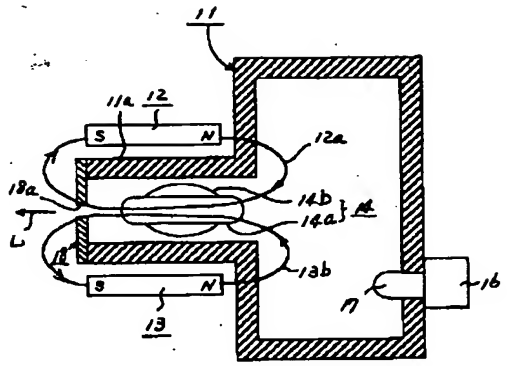
[Drawing 2]



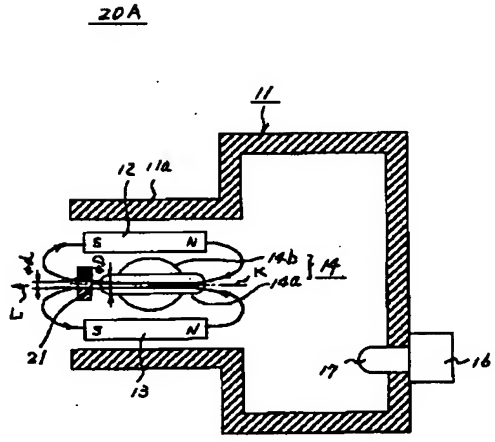
[Drawing 3]



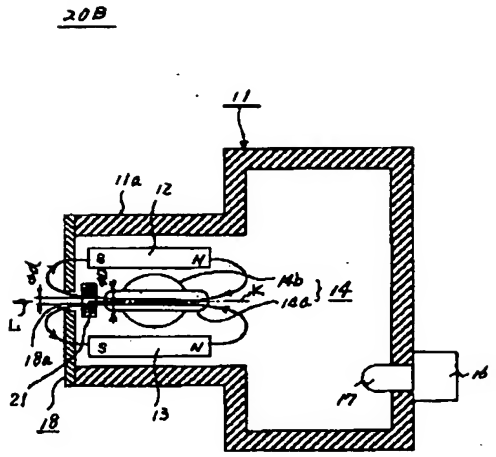
[Drawing 4]



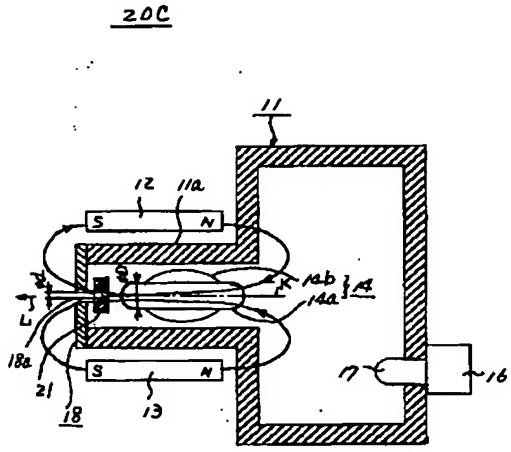
[Drawing 5]



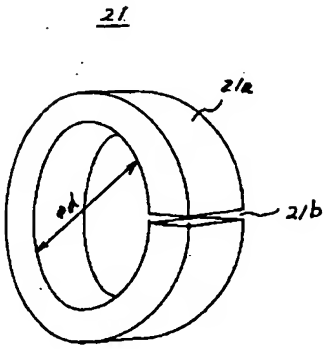
[Drawing 6]



[Drawing 7]



[Drawing 8]



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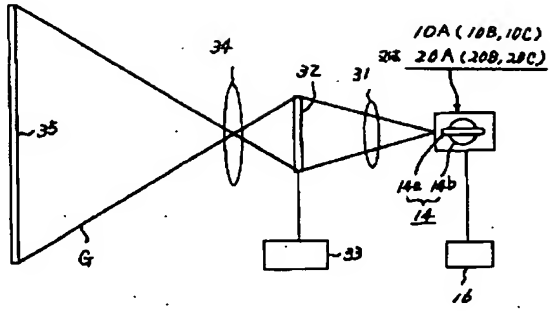
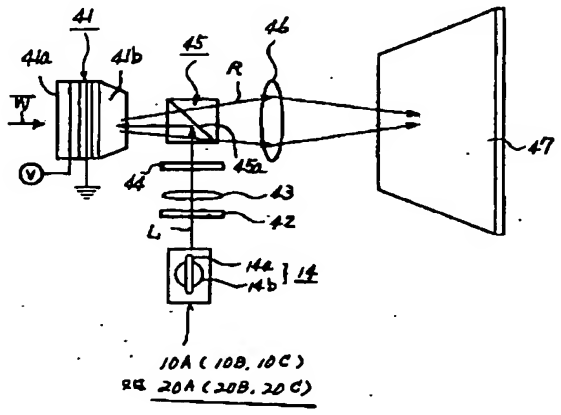
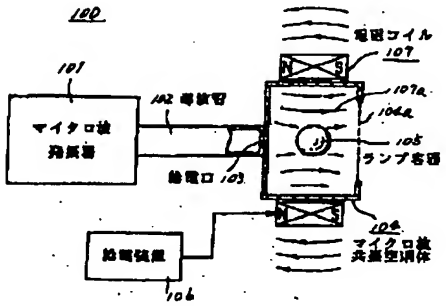


[Drawing 10]



[Drawing 11]



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EUROPEAN PATENT OFFICE

Patent Abstracts of Japan

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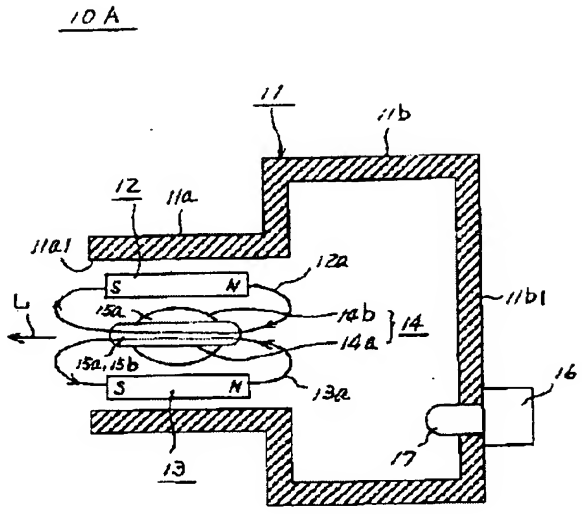
APPLICATION NUMBER : 11352768

APPLICANT : VICTOR CO OF JAPAN LTD;

INVENTOR : OHARA TERUMI;

INT.CL. : H05B 41/24 H01J 65/04

TITLE : MICROWAVE DISCHARGE LIGHT SOURCE DEVICE AND PICTURE DISPLAY DEVICE USING THE SAME



ABSTRACT : PROBLEM TO BE SOLVED: To enable electron to emit light in a electrode-less lamp with ease.

SOLUTION: The microwave discharge light source device 10 characterized by the construction which comprises a magnetron 16 generating microwave; a resonator 11 with an opening part 11a1 emitting light while making microwave resonate; an electrode-less lamp 14 constructed integrally with first lamp part 14a mounted in the resonator, sealing rare gas 15a and discharging media 15b inside, discharging by dint of the microwave, formed in lengthened shape turning its longitudinal direction toward the opening, and the second lamp part 14b sealing only the rare gas 15a discharging by din of microwave, formed so as to cover the longitudinal peripheral part of the first lamp part, and magnetic force generating means 12, 13 generating lines of magnetic force parallel to the longitudinal direction of the first lamp part of the electrode-less lamp and the direction of the light emitted from the electrode less lamp.

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(51)Int.Cl.[7]	識別記号	Ｆ Ｉ		テーマコード（参考）	
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Ｈ０１Ｊ　65/04		Ｈ０１Ｊ　65/04		Ｂ	５Ｃ０３９

審査請求　未請求　請求項の数８　ＯＬ　（全 10 頁）

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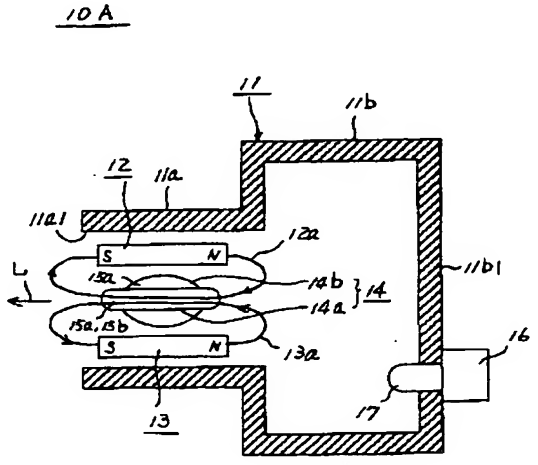
(71)出願人　000004329
日本ビクター株式会社
神奈川県横浜市神奈川区守屋町３丁目12番地
(72)発明者　山村　隆
神奈川県横浜市神奈川区守屋町３丁目12番地　日本ビクター株式会社内
(72)発明者　大原　輝美
神奈川県横浜市神奈川区守屋町３丁目12番地　日本ビクター株式会社内

Ｆターム(参考)　3K072 AA17 CA16 GB07
5C039 PP02 PP14

(54)【発明の名称】　マイクロ波放電光源装置及びこのマイクロ波放電光源装置を用いた画像表示装置

(57)【要約】
【課題】　無電極ランプ内で電子を発光し易くする。
【解決手段】　マイクロ波を発生するマグネトロン１６と、前記マイクロ波を共振させると共に、光を出射させる開口部１１ａ１を形成した共振器１１と、前記共振器内に設けられ、且つ、前記マイクロ波によって放電される希ガス１５ａ及び放電媒体１５ｂを封入して長手方向を前記開口部側に向かって長尺に形成した第１ランプ部１４ａと、前記マイクロ波によって放電される希ガス１５ａのみを封入して前記第１ランプ部の長手方向外周部位を覆った第２ランプ部１４ｂとで一体的に形成した無電極ランプ１４と、前記無電極ランプの第１ランプ部の長手方向及び該無電極ランプからの出射光の出射方向に平行な磁力線を発生させる磁力発生手段１２，１３とを具備したことを特徴とするマイクロ波放電光源装置１０を提供する。



【特許請求の範囲】
【請求項１】マイクロ波を発生するマグネトロンと、
前記マイクロ波を共振させると共に、光を出射させる開口部を形成した共振器と、
前記共振器内に設けられ、且つ、前記マイクロ波によって放電される希ガス及び放電媒体を封入して長手方向を前記開口部側に向かって長尺に形成した第１ランプ部と、前記マイクロ波によって放電される希ガスのみを封入して前記第１ランプ部の長手方向外周部位を覆った第２ランプ部とで一体的に形成した無電極ランプと、
前記無電極ランプの第１ランプ部の長手方向及び該無電極ランプからの出射光の出射方向に平行な磁力線を発生させる磁力発生手段とを具備したことを特徴とするマイクロ波放電光源装置。
【請求項２】マイクロ波を発生するマグネトロンと、
前記マイクロ波を共振させると共に、光を出射させる開口部を形成した共振器と、
前記共振器内に設けられ、且つ、前記マイクロ波によって放電される希ガス及び放電媒体を封入して長手方向を前記開口部側に向かって長尺に形成した第１ランプ部と、前記マイクロ波によって放電される希ガスのみを封入して前記第１ランプ部の長手方向外周部位を覆った第２ランプ部とで一体的に形成した無電極ランプと、
前記無電極ランプの第１ランプ部の長手方向及び該無電極ランプからの出射光の出射方向に平行な磁力線を発生させる磁力発生手段と、
前記無電極ランプからの出射光の光軸上に設けられ、電磁誘導性と電気容量性とを併せもったループギャップ共振器とを具備したことを特徴とするマイクロ波放電光源装置。
【請求項３】前記ループギャップ共振器を略円管状に形成し、且つ、このループギャップ共振器の内径が前記無電極ランプの第１ランプ部のランプ径より小なることを特徴とする請求項２記載のマイクロ波放電光源装置。
【請求項４】前記共振器に形成した前記開口部を、前記磁力線の方向に対して略鉛直に開口したことを特徴とする請求項１～請求項３のいずれか１項記載のマイクロ波放電光源装置。
【請求項５】前記磁力発生手段は、永久磁石により前記磁力線を発生させるようにしたことを特徴とする請求項１～請求項４のいずれか１項記載のマイクロ波放電光源装置。
【請求項６】前記磁力発生手段は、電磁コイルにより前記磁力線を発生させるようにしたことを特徴とする請求項１～請求項４のいずれか１項記載のマイクロ波放電光源装置。
【請求項７】前記共振器に形成した前記開口部の開口面積が前記無電極ランプの第１ランプ部のランプ径より小なることを特徴とする請求項１乃至請求項６のいずれか１項記載のマイクロ波放電光源装置。
【請求項８】請求項１乃至請求項７のいずれか１項記載のマイクロ波放電光源装置を画像表示用の投射用光源として用いたことを特徴とする画像表示装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、無電極ランプ内の放電媒体をマイクロ波によって励起させるマイクロ波放電光源装置及びこのマイクロ波放電光源装置を用いた画像表示装置に関するものである。
【０００２】
【従来の技術】従来、周知の電極を持たないマイクロ波放電光源装置は、照明装置などの広い範囲を照射する装置として利用されていたため、発光部がある程度広範囲でも問題がなかった。しかしながら、近年、マイクロ波放電光源装置を画像表示装置の光源として利用することが考えられるに至り、光学系により光束を制御する必要が出て来たが、点光源化が困難なため、光束を収束させて高輝度化を図ることが出来なかった。これを解決する手段としてランプから出射する出射光側に開口面積の小さいマスクを設けることが行われていたが、ランプが全体的に一様に発光しているため開口から出射する光量はその一部にすぎず、極めて効率の悪いものとなっている。
【０００３】また、図１１に示した如く、特開平７－１８３００８号公報に開示されたマイクロ波放電光源装置は、電子サイクロトロン共鳴を利用する方法の一例である。
【０００４】図１１に示した従来例の一例としてのマイクロ波放電光源装置１００では、マイクロ波を発振するマイクロ波発振器１０１と、このマイクロ波発振器１０１で発振されたマイクロ波を導く導波管１０２と、この導波管１０２に給電口１０３を通じて接続され且つ前方側に開口部１０４ａが形成された円筒状のマイクロ波共振空洞体１０４と、このマイクロ波共振空洞体１０４内に設けられその内部にマイクロ波によって励起されて放電発光する放電発光物質が収容された中空球形状のランプ容器１０５と、このランプ容器１０５に給電装置１０６を介して磁場を印加する電磁石又は永久磁石１０７とを備えて構成されている。
【０００５】そして、マイクロ波発振器１０１から発振されたマイクロ波は導波管１０２を伝わり給電口１０３からマイクロ波共振空洞体１０４内に給電され、マイクロ波によってランプ容器１０５内の放電発光物質が励起されて放電発光した時に、電磁石又は永久磁石１０７による磁場の磁力線１０７ａがマイクロ波の進行方向とほぼ平行に発生しているため、この磁場の影響でランプ容器１０５内に存在する電子に図１２に示したような螺旋状の回転運動を起こさせ、いわゆる電子サイクロトン共鳴が起きる。この後、ランプ容器１０５内で放電発光した光は磁場を加えない場合よりも螺旋状に回転運動する

分だけ光の発光パス（距離）及び発光期間が長くなり、発光した光がマイクロ波共振空洞体１０４の開口部１０１ａから出射されている

【０００６】

【発明が解決しようとする課題】ところで、図１１に示した従来のマイクロ波放電光源装置１００によれば、上述したように、ランプ容器１０５内の電子が回転運動する分だけ光の発光パス及び発光期間が長くなり、発光する機会が増えるものの、ランプ容器１０５の形状が中空球形状であるため、ランプ容器１０５の球径を大きくしないかぎり回転運動のパスを増加させることができず、仮にランプ容器１０５の球径を大きくすれば発光部が大きくなってしまうと共に、マイクロ波放電光源装置１００も大型になってしまう。

【０００７】また、マイクロ波共振空洞体１０４の前方に開口した開口部１０４ａの開口面積も大きいため、画像表示装置などに用いる場合に点光源として利用するに充分小さく且つ高輝度の発光源にはなりえないなどの問題が生じている。

【０００８】

【課題を解決するための手段】本発明は上記課題に鑑みてなされたものであり、第１の発明は、マイクロ波を発生するマグネトロンと、前記マイクロ波を共振させると共に、光を出射させる開口部を形成した共振器と、前記共振器内に設けられ、且つ、前記マイクロ波によって放電される希ガス及び放電媒体を封入して長手方向を前記開口部側に向かって長尺に形成した第１ランプ部と、前記マイクロ波によって放電される希ガスのみを封入して前記第１ランプ部の長手方向外周部位を覆った第２ランプ部とで一体的に形成した無電極ランプと、前記無電極ランプの第１ランプ部の長手方向及び該無電極ランプからの出射光の出射方向に平行な磁力線を発生させる磁力発生手段とを具備したことを特徴とするマイクロ波放電光源装置である。

【０００９】また、第２の発明は、マイクロ波を発生するマグネトロンと、前記マイクロ波を共振させると共に、光を出射させる開口部を形成した共振器と、前記共振器内に設けられ、且つ、前記マイクロ波によって放電される希ガス及び放電媒体を封入して長手方向を前記開口部側に向かって長尺に形成した第１ランプ部と、前記マイクロ波によって放電される希ガスのみを封入して前記第１ランプ部の長手方向外周部位を覆った第２ランプ部とで一体的に形成した無電極ランプと、前記無電極ランプの第１ランプ部の長手方向及び該無電極ランプからの出射光の出射方向に平行な磁力線を発生させる磁力発生手段と、前記無電極ランプからの出射光の光軸上に設けられ、電磁誘導性と電気容量性とを併せてもったループギャップ共振器とを具備したことを特徴とするマイクロ波放電光源装置である。

【００１０】また、第３の発明は、上記した第２の発明のマイクロ波放電光源装置において、前記ループギャップ共振器を略円管状に形成し、且つ、このループギャップ共振器の内径が前記無電極ランプの第１ランプ部のランプ径より小なることを特徴とするものである

【００１１】また、第４の発明は、上記した第１～請求項３の発明のいずれかのマイクロ波放電光源装置において、前記共振器に形成した前記開口部を、前記磁力線の方向に対して略鉛直に開口したことを特徴とするものである。

【００１２】また、第５の発明は、上記した第１～請求項４の発明のいずれかのマイクロ波放電光源装置において、前記磁力発生手段は、永久磁石により前記磁力線を発生させるようにしたことを特徴とするものである。

【００１３】また、第６の発明は、上記した第１～請求項４の発明のいずれかのマイクロ波放電光源装置において、前記磁力発生手段は、電磁コイルにより前記磁力線を発生させるようにしたことを特徴とするものである。

【００１４】また、第７の発明は、上記した第１～第６の発明のいずれかのマイクロ波放電光源装置において、前記共振器に形成した前記開口部の開口面積が前記無電極ランプのランプ径より小なることを特徴とするものである。

【００１５】更に、第８の発明は、上記した第１～第７の発明のいずれかのマイクロ波放電光源装置を画像表示用の投射用光源として用いたことを特徴とする画像表示装置である。

【００１６】

【発明の実施の形態】以下に本発明に係るマイクロ波放電光源装置及びこのマイクロ波放電光源装置を用いた画像表示装置の一実施例を図１乃至図１０を参照して＜第１実施例＞，＜第２実施例＞，＜第３実施例＞の順に詳細に説明する。

【００１７】＜第１実施例＞図１は本発明に係る第１実施例のマイクロ波放電光源装置を示した断面図、図２は図１に示した第１実施例のマイクロ波放電光源装置において、磁場の影響で無電極ランプ内で発生した電子の回転運動を説明するための図、図３は第１実施例のマイクロ波放電光源装置を一部変形した第１変形例を示した断面図、図４は第１実施例のマイクロ波放電光源装置を一部変形した第２変形例を示した断面図である。

【００１８】図１に示した如く、本発明に係る第１実施例のマイクロ波放電光源装置１０Ａでは、共振器１１が小径部１１ａと大径部１１ｂとで段付き円筒形状に形成されている。尚、実施例では、共振器１１を段付き円筒形状に形成しているが、これに限ることなく、単なる円筒形状でも良く、更に、箱形状でも良い。また、共振器１１の小径部１１ａには、先端を開口した開口部１１ａ１が形成されており、この小径部１１ａの内径に沿って断面が三日月状の永久磁石１２，１３が互いに対向して一対固着されている。尚、実施例では永久磁石１２，１

3を互いに対向して一対設けているが、これに限ることなくいずれか一方だけでも良く、更に、複数対あった方が効果が大きい。また、ドーナツ状（リング状）の永久磁石を用いても良いし、永久磁石に代えて電磁石を用いることも可能である。

【００１９】また、共振器１１の小径部１１ａ内で開口部１１ａ１側に無電極ランプ１４が、一対の永久磁石１２，１３の内側に固着されている。この無電極ランプ１４は第１実施例の要部となるものであり、透明な石英ガラスを用いて両端を半球状に形成し且つ長手方向を開口部１１ａ１側に向かって長尺な円筒状に形成して内部にマイクロ波によって放電される希ガス１５ａ及び放電媒体１５ｂを封入した第１ランプ１４ａと、透明な石英ガラスを用いて楕円状に形成し且つ第１ランプ部１４ａの長手方向外周部位を覆って内部にマイクロ波によって放電される希ガス１５ａのみを封入した第２ランプ１４ｂとで一体的に形成されている。

【００２０】この際、無電極ランプ１４の第１ランプ１４ａ内には、マイクロ波によって放電される希ガス１５ａとしてアルゴン、ネオン、キセノン、クリプトン等が封入され、且つ、マイクロ波によって放電される放電媒体１５ｂとしてガリウム・インジウム・タリウム等の金属ハロゲン化物、水銀、亜鉛、硫黄、セレン、テルル等が封入されている。一方、無電極ランプ１４の第２ランプ１４ｂ内には、マイクロ波によって放電される希ガス１５ａとしてアルゴン、ネオン、キセノン、クリプトン等が封入されている。そして、無電極ランプ１４は、後述するように外側の第２ランプ１４ｂが内側の第１ランプ１４ａより先に放電を開始できるように第２ランプ１４ｂ内の希ガス１５ａのガス圧、ガス容量が設定されている。勿論、無電極ランプ１４の第１，第２ランプ部１４ａ，１４ｂ内には電極がないために長寿命化が図れるものである。尚、実施例では、無電極ランプ１４の第１ランプ部１４ａの両端を半球状に形成しているが、これに限ることなく、両端をフラットに形成しても良く、光の出射側でない方の端部は突起状でも良い。

【００２１】この際、一対の永久磁石１２，１３と無電極ランプ１４との間に図示しない誘電性セラミックスを充填又は焼結することで無電極ランプ１４が一対の永久磁石１２，１３を介して共振器１１の小径部１１ａ内に固着されている。

【００２２】また、一対の永久磁石１２，１３を共振器１１の小径部１１ａ内に取り付ける際に、一対の永久磁石１２，１３からそれぞれ発生する磁力線１２ａ，１３ａの方向が無電極ランプ１４の第１ランプ部１４ａの長手方向及びこの無電極ランプ１４からの出射光Ｌの出射方向（矢印方向）と平行になるように各磁石１２，１３のＳ極及びＮ極をそれぞれ設定している。

【００２３】また、共振器１１の大径部１１ｂの底面部１１ｂ１の外側には、マイクロ波を発生するマグネトロン１６が取り付けられている。また、マグネトロン１６で発生したマイクロ波を発信するアンテナ１７が共振器１１の大径部１１ｂ内に突出している。これにより、アンテナ１７から発信されたマイクロ波が共振器１１の大径部１１ｂ内で共振されて、共振したマイクロ波を無電極ランプ１４内に給電している。

【００２４】そして、無電極ランプ１４では、まず、共振したマイクロ波により第２ランプ部１４ｂ内の希ガス１５ａが放電を開始してプラズマ状態となり、これにより第２ランプ部１４ｂ内のインピーダンスが下がる。これに伴って、マイクロ波が第１ランプ部１４ａに集中し易くなるので、第１ランプ部１４ａ内の希ガス１５ａが放電してプラズマ状態となり、無電極ランプ１４全体に入る電力が増大し、無電極ランプ１４の第１ランプ部１４ａのガラス壁の温度が上昇して、第１ランプ部１４ａ内に封入されている放電媒体１５ｂ中の金属が蒸発し高温部で解離し凝縮して粒子となりこの粒子が放電の加熱で金属特有のスペクトル発光をする。この粒子は無電極ランプ１４の第１ランプ部１４ａ内の低温部へ移動し、水素・酸素との反応により金属化したのち蒸発・解離・凝縮・発光を繰り返す。

【００２５】ここで、一対の永久磁石１２，１３からそれぞれ発生する磁力線１２ａ，１３ａの方向が無電極ランプ１４の第１ランプ部１４ａの長手方向及びこの無電極ランプ１４からの出射光Ｌの出射方向（矢印方向）と平行になっているので、磁力線１２ａ，１３ａの方向により、電子サイクロトロン共鳴が起こり無電極ランプ１４の第１ランプ部１４ａ内に発生した電子が共振器１１の小径部１１ａに形成した開口部１１ａ側の出射方向に向かって図２に示したように磁力線１２ａ，１３ａ間で螺旋状に回転運動するので、出射光Ｌが共振器１１の小径部１１ａに形成した開口部１１ａから出射される。この際、無電極ランプ１４の第１ランプ部１４ａ内に発生した電子の回転半径（ラーモア半径）は無電極ランプ１４の第１ランプ部１４ａのランプ径φＤより充分小さく、且つ、電子の螺旋状の回転運動により光の発光パス（距離）及び発光期間を非常に長くすることが出来ると共に、電子が第１ランプ部１４ａのランプ壁に衝突してエネルギーを失うまでの距離も長くすることが出来、電子が自由に運動していたときにランプ壁に衝突して消費していたマイクロ波のエネルギーを効率良く利用することが出来る。

【００２６】また、磁束密度の高いほど電子サイクロトロン共鳴を起こし易くなることから無電極ランプ１４の第１ランプ部１４ａの長手方向に平行な磁力線が形成されるように一対の永久磁石１２，１３を無電極ランプ１４を挟んで配置することにより、無電極ランプ１４の第１ランプ部１４ａの長手方向の中心部近傍が磁束密度が高くなり円柱状に強く発光する。そして、発光した光は、無電極ランプ１４の第１ランプ部１４ａの半球状の

端部から出射光Lとして取り出す。ここで、共振器１１の小径部１１ａに形成した開口部１１ａを磁力線１２ａ，１３ａの方向に対して略鉛直に開口することで、開口部１１ａは出射光Lの光束に略鉛直な断面を取る形となり、出射光Lの中心部が明るく小面積の点光源が得られる。

【００２７】次に、図１に示した第１実施例のマイクロ波放電光源装置１０Ａを一部変形した第１変形例について図３を用いて簡略に説明する。尚、図３では先に説明した第１実施例のマイクロ波放電光源装置１０Ａの構成部材と同一構成部材に対して同一の符番を付すと共に、以下の説明では先に説明した第１実施例のマイクロ波放電光源装置１０Ａと異なる点についてのみ説明する。

【００２８】図３に示した如く、第１変形例のマイクロ波放電光源装置１０Ｂでは、共振器１１の小径部１１ａの先端に開口した開口部１１ａ１に、無電極ランプ１４の第１ランプ部１４ａのランプ径φＤより充分小さい直径で略１ｍｍ以下の中心孔１８ａを穿設した蓋１８を取り付けることで、この中心孔１８ａから出射した出射光Lがより鮮明な点光源として得られ、中心孔１８ａの開口面積が小さくとも効率良く出射光Lを取り出すことが出来る。また、中心孔１８ａを穿設した蓋１８に金属材料を用いたり、又は、金網と遮光部材とを組み合わせて用いることでマイクロ波の外部への漏洩を防止する効果が得られる。

【００２９】次に、図１に示した第１実施例のマイクロ波放電光源装置１０Ａ又は第１変形例のマイクロ波放電光源装置１０Ｂを一部変形した第２変形例について図４を用いて簡略に説明する。尚、図４では先に説明したマイクロ波放電光源装置１０Ａ，１０Ｂの構成部材と同一構成部材に対して同一の符番を付すと共に、以下の説明では先に説明したマイクロ波放電光源装置１０Ａ，１０Ｂと異なる点についてのみ説明する。また、図４では共振器１１の小径部１１ａの先端に略１ｍｍ以下の中心孔１８ａを穿設した蓋１８を取り付けているが、第２変形例では蓋１８を必要に応じて取り付けつければ良いものとする。

【００３０】ここで、前記した第１実施例のマイクロ波放電光源装置１０Ａ又は第１変形例のマイクロ波放電光源装置１０Ｂにおいて、マイクロ波により無電極ランプ１４の温度が略５００°Ｃ～１０００°Ｃと高温になるため、共振器１１の小径部１１ａ内に設けた一対の永久磁石１２，１３は無電極ランプ１４からの高熱により極端に磁化の強さが減じてしまう。勿論、永久磁石１２，１３を用いずに電磁石を用いた場合でも上記と同様に減磁される。

【００３１】そこで、図４に示した如く、第２変形例のマイクロ波放電光源装置１０Ｃでは、共振器１１の小径部１１ａの外側に三日月状の永久磁石１２，１３を互いに対向して図示しない保持部材を用いて一対保持させている。尚、第２変形例でも一対の永久磁石１２，１３を互いに対向させて設けているが、これに限ることなくいずれか一方だけでも良く、更に、複数対あった方が効果が大きい。また、ドーナツ状（リング状）の永久磁石を用いても良いし、永久磁石に代えて電磁石を用いることも可能である。

【００３２】ここで、一対の永久磁石１２，１３を共振器１１の小径部１１ａの外側に設ける際に、少なくとも共振器１１の小径部１１ａ部位は、比透磁率の小さい材料を用いて形成するか、あるいは導電性のあるメッシュ材料を用いて形成することで、無電極ランプ１４からの高熱の影響を低減して磁力線１２ａ，１３ａの集中を行わせることが出来る。

【００３３】上記構成によるマイクロ波放電光源装置１０Ａ（又は１０Ｂ，もしくは１０Ｃ）は、無電極ランプ１４により長寿命化が図れ、且つ、無電極ランプ１４を構成する内側の第１ランプ部１４ａに希ガス１５ａ及び放電媒体１５ｂを封入し、無電極ランプ１４を構成する外側の第２ランプ部１４ｂに希ガス１５ａのみを封入することにより、まず、共振したマイクロ波により第２ランプ部１４ｂ内の希ガス１５ａが放電を開始してプラズマ状態となり、これにより第２ランプ部１４ｂ内のインピーダンスが下がるので、これに伴って、マイクロ波が第１ランプ部１４ａに集中し易くなり、第１ランプ部１４ａ内で電子が発光し易くなり、金属特有のスペクトル発光をすることができる。また、無電極ランプ１４の第１ランプ部１４ａの長手方向及びこの無電極ランプ１４からの出射光Lの出射方向と平行な磁力線１２ａ，１３ａを無電極ランプ１４に与えて光の発光パス（距離）及び発光期間を長くすることで、出射光Lの出射方向に対して放電効率を上げ高輝度化し小さい面積から出射光Lを出射させることで、無電極ランプ１４からの出射光Lを点光源として利用できる。

【００３４】＜第２実施例＞図５は本発明に係る第２実施例のマイクロ波放電光源装置を示した断面図、図６は第２実施例のマイクロ波放電光源装置を一部変形した第１変形例を示した断面図、図７は第２実施例のマイクロ波放電光源装置を一部変形した第２変形例を示した断面図、図８は図５～図７に示したマイクロ波放電光源装置において、ループギャップ共振器を拡大して示した斜視図である。

【００３５】図５に示した本発明に係る第２実施例のマイクロ波放電光源装置２０Ａ及び図６に示した第２実施例を一部変形した第１変形例のマイクロ波放電光源装置２０Ｂ並びに図７に示した第２実施例を一部変形した第２変形例のマイクロ波放電光源装置２０Ｃは、先に説明した第１実施例におけるマイクロ波放電光源装置１０Ａ，１０Ｂ，１０Ｃとそれぞれ対応関係があり、ここでは第１実施例におけるマイクロ波放電光源装置１０Ａ，１０Ｂ，１０Ｃと異なる点についてのみ新たな符番を付

して説明する

【００３６】図５（又は図６，もしくは図７）に示したマイクロ波放電光源装置２０Ａ（又は２０Ｂ，もしくは２０Ｂ）において、共振器１１の小径部１１ａ内に設けた無電極ランプ１４の光の出射側でこのランプ１４の光軸Ｋ上には、第２実施例の要部となる円管状のループギャップ共振器２１が設けられている。この際、ループギャップ共振器２１の中心軸を無電極ランプ１４の光軸Ｋに合わせることでループギャップ共振器２１の中心軸方向は無電極ランプ１４からの出射光Ｌの出射方向（矢印方向）と平行になると共に、ループギャップ共振器２１は無電極ランプ１４の光軸Ｋに対して略直交して設けられている。尚、実施例では、ループギャップ共振器２１を無電極ランプ１４の光の出射側に設けているが、無電極ランプ１４の両端に設けても良い。

【００３７】また、円管状のループギャップ共振器２１の外周部位と、無電極ランプ１４の外周部位及び又は一対の永久磁石１２，１３の内周部位との間で図示しない誘電性セラミックスを充填することで、ループギャップ共振器２１は共振器１１と一体となって共振器１１と同一の共振周波数を持つ構造となる。また、ループギャップ共振器２１は、後述するように電磁誘導性と電気容量性とを併せ持つ構造形態を採用している。

【００３８】即ち、図８に拡大して示した如く、ループギャップ共振器２１は、銅，アルミ，銀などの導電性材料からなる略円管状の共振環部２１ａと、この共振環部２１ａの一部を細い幅で切り欠いたギャップ部２１ｂとからなり、共振環部２１ａの内径φｄが無電極ランプ１４の第１ランプ部１４のランプ径φＤより小さく形成されている。尚、実施例では、円管状の共振環部２１ａに一つのギャップ部２１ｂを形成したが、これに限ることなく、円管状の共振環部２１ａに複数のギャップ部２１ｂを形成して、各ギャップ部２１ｂに誘電性セラミックスを充填して保持することで電磁的にループ状にすることも可能である。

【００３９】ここで、ループギャップ共振器２１の中心軸方向を変動電磁場の磁束の方向と平行になるように配置すると、共振環部２１ａが電磁誘導性を持つので円周方向に渦状の誘導電位が生じ、これによりギャップ部２１ｂに電場が生じて電気容量性を持つものである。

【００４０】従って、マイクロ波放電光源装置２０Ａ（又は２０Ｂ、もしくは２０Ｃ）では、ループギャップ共振器２１によりマイクロ波のエネルギーを効率良く無電極ランプ１４内に導いて、無電極ランプ１４の出射光Ｌの出射方向に対して放電効率を上げ高輝度化し小さい面積から出射光Ｌを出射させることで、無電極ランプ１４からの出射光Ｌを点光源として利用できる。

【００４１】＜第３実施例＞図９は本発明に係るマイクロ波放電光源装置を用いた画像表示装置として透過型の場合を示した構成図、図１０は本発明に係るマイクロ波放電光源装置を用いた画像表示装置として反射型の場合を示した構成図である

【００４２】まず、図９に示した如く、透過型の画像表示装置３０は、先に説明した第１実施例（又は第２実施例）におけるマイクロ波放電光源装置１０Ａ～１０Ｃ（又は２０Ａ～２０Ｃ）を構成する無電極ランプ１４から出射した出射光Ｌがレンズ３１により透過型液晶板３２に照射される。この透過型液晶板３２は、液晶駆動回路３３からの画像信号により所望の画像を表示する。透過型液晶板３２を透過した画像光Ｇは投射レンズ３４により拡大されてスクリーン３５上に拡大投射される。

【００４３】従って、先に説明したマイクロ波放電光源装置１０Ａ～１０Ｃ（又は２０Ａ～２０Ｃ）を用いて無電極ランプ１４の出射光Ｌの出射方向に対して放電効率を上げ高輝度化し小さい面積から出射光Ｌを出射させることで、無電極ランプ１４からの出射光Ｌを点光源として利用できるので、透過型の画像表示装置３０の投射用光源として低消費電力であり、且つ、画像を高輝度／高画質／高精細に拡大投射できる。

【００４４】次に、図１０に示した如く、反射型の画像表示装置４０は、光アドレス型空間変調素子４１の一方の面４１ａに画像信号に応じた書き込み光Ｗが照射されて光情報が書き込まれ、この光情報が内部で増幅されている。

【００４５】一方、先に説明した第１実施例（又は第２実施例）におけるマイクロ波放電光源装置１０Ａ～１０Ｃ（又は２０Ａ～２０Ｃ）を構成する無電極ランプ１４から出射した出射光Ｌは、赤外線カットフィルタ４２、レンズ４３、波長フィルタ４４を通ってポラリゼーション・ビームスプリッタ４５に入射され、ポラリゼーション・ビームスプリッタ４５の半透過反射膜４５ａで反射されて反射光が光アドレス型空間変調素子４１の他方の面４１ｂに照射され、この他方の面４１ｂで画像情報を含んだ読み出し光Ｒとして反射される。この後、画像情報を含んだ読み出し光Ｒは、ポラリゼーション・ビームスプリッタ４５の半透過反射膜４５ａを透過して投射レンズ４６により拡大されてスクリーン４７上に拡大投射される。

【００４６】従って、先に説明したマイクロ波放電光源装置１０Ａ～１０Ｃ（又は２０Ａ～２０Ｃ）を用いて無電極ランプ１４の出射光Ｌの出射方向に対して放電効率を上げ高輝度化し小さい面積から出射光Ｌを出射させることで、無電極ランプ１４からの出射光Ｌを点光源として利用できるので、反射型の画像表示装置４０の投射用光源として低消費電力であり、且つ、画像を高輝度　高画質　高精細に拡大投射できる．

【００４７】

【発明の効果】以上詳述した本発明に係る本発明に係るマイクロ波放電光源装置において、請求項１記載によると、無電極ランプにより長寿命化が図れ、且つ、無電極

ランプを構成する内側の第１ランプ部に希ガス及び放電媒体を封入し、無電極ランプを構成する外側の第２ランプ部に希ガスのみを封入することにより、まず、共振したマイクロ波により第２ランプ部内の希ガスが放電を開始してプラズマ状態となり、これにより第２ランプ部内のインピーダンスが下がるので、これに伴って、マイクロ波が第１ランプ部に集中し易くなり、第１ランプ部内で電子が発光し易くなり、金属特有のスペクトル発光をすることができる。また、無電極ランプの第１ランプ部及びこの無電極ランプからの出射光の出射方向と平行な磁力線を無電極ランプに与えて光の発光パス（距離）及び発光期間を長くすることで、出射光の出射方向に対して放電効率を上げ高輝度化し小さい面積から出射光を出射させることで、無電極ランプからの出射光を点光源として利用できる。

【００４８】また、請求項２記載によると、請求項１記載と同様の効果が得られると共に、更に、ループギャップ共振器によりマイクロ波のエネルギーを効率良く無電極ランプ内に導いて、無電極ランプの出射光の出射方向に対して放電効率を上げ高輝度化し小さい面積から出射光を出射させることで、無電極ランプからの出射光を点光源として利用できる。

【００４９】また、本発明に係るマイクロ波放電光源装置を用いた画像表示装置によれば、上記した無電極ランプの性能による点光源を画像表示用の投射用光源として用いているので、画像表示装置の低消費電力に寄与でき、且つ、マイクロ波放電光源装置により画像を高輝度、高画質、高精細に拡大投射できる。

【図面の簡単な説明】

【図１】本発明に係る第１実施例のマイクロ波放電光源装置を示した断面図である。

【図２】図１に示した第１実施例のマイクロ波放電光源装置において、磁場の影響で無電極ランプ内で発生した電子の回転運動を説明するための図である。

【図３】第１実施例のマイクロ波放電光源装置を一部変形した第１変形例を示した断面図である。

【図４】第１実施例のマイクロ波放電光源装置を一部変形した第２変形例を示した断面図である。

【図５】本発明に係る第２実施例のマイクロ波放電光源装置を示した断面図である。

【図６】第２実施例のマイクロ波放電光源装置を一部変形した第１変形例を示した断面図である。

【図７】第２実施例のマイクロ波放電光源装置を一部変形した第２変形例を示した断面図である。

【図８】図５～図７に示したマイクロ波放電光源装置において、ループギャップ共振器を拡大して示した斜視図である。

【図９】本発明に係るマイクロ波放電光源装置を用いた画像表示装置として透過型の場合を示した構成図である。

【図１０】本発明に係るマイクロ波放電光源装置を用いた画像表示装置として反射型の場合を示した構成図である。

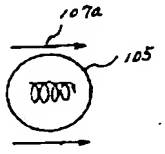
【図１１】従来例の一例としてマイクロ波放電光源装置を示した構成図である。

【図１２】図１２に示したマイクロ波放電光源装置において、磁場の影響でランプ容器内に存在する電子の回転運動を説明するための図である。

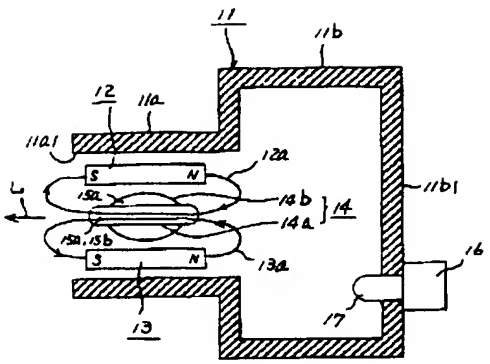
【符号の説明】

１０Ａ…本発明に係る第１実施例のマイクロ波放電光源装置、１０Ｂ…第１実施例を一部変形した第１変形例のマイクロ波放電光源装置、１０Ｃ…第１実施例を一部変形した第２変形例のマイクロ波放電光源装置、１１…共振器１１、１１ａ…小径部、１１ａ１…開口部、１１ｂ…大径部、１２，１３…永久磁石、１２ａ，１３ａ…磁力線、１４…無電極ランプ、１４ａ…第１ランプ部、１４ｂ…第２ランプ部、１５ａ…希ガス、１５ｂ…放電媒体、１６…マグネトロン、１８…蓋、１８ａ…中心孔、２０Ａ…本発明に係る第２実施例のマイクロ波放電光源装置、２０Ｂ…第２実施例を一部変形した第１変形例のマイクロ波放電光源装置、２０Ｃ…第２実施例を一部変形した第２変形例のマイクロ波放電光源装置、２１…ループギャップ共振器、３０…本発明に係るマイクロ波放電光源装置を用いた透過型の画像表示装置、４０…本発明に係るマイクロ波放電光源装置を用いた反射型の画像表示装置、Ｌ…出射光。

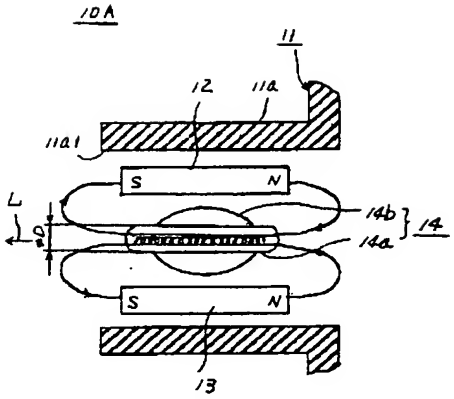
【図１２】



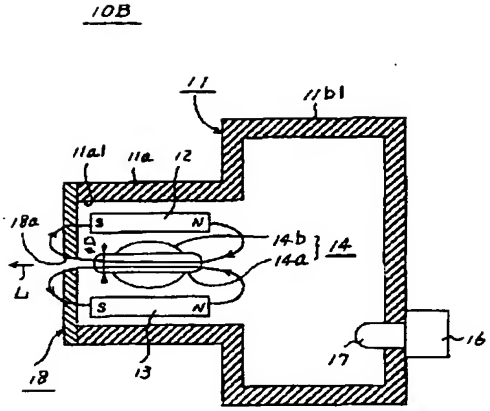
【図1】


10A
11
11b
12
11a
11a1
12a
S
N
14b
14
14a
11b1
16
13a
13
17

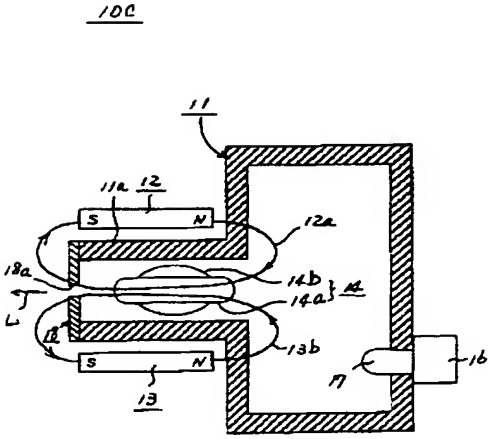
【図2】


10A
11
12
11a
11a1
S
N
14b
14
14a
13
17

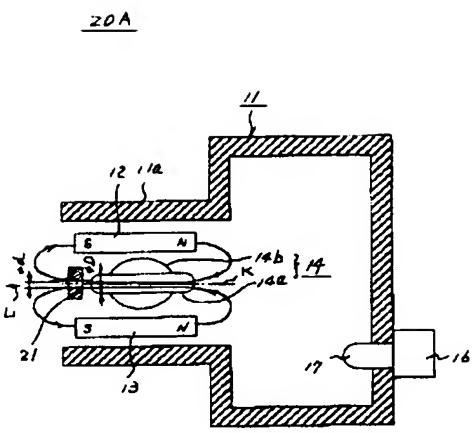
【図3】


10B
11
11b1
11a1
11a
12
18a
S
N
14b
14
14a
16
18
13
17

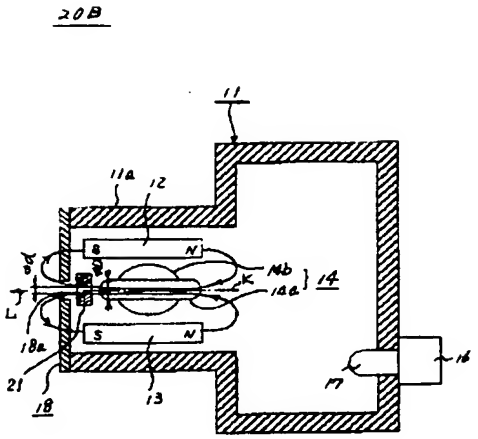
【図4】


10C
11
11a
12
S
N
12a
18a
14b
14
14a
13b
16
13
17

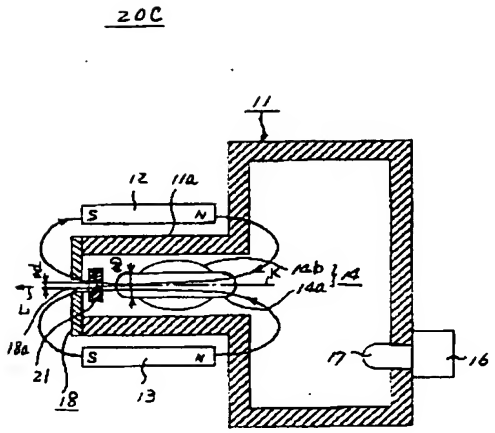
【図5】



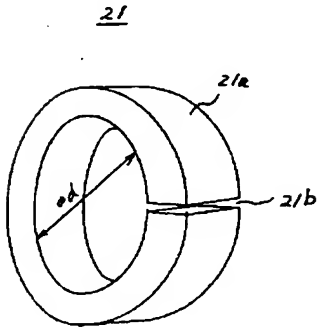
【図6】



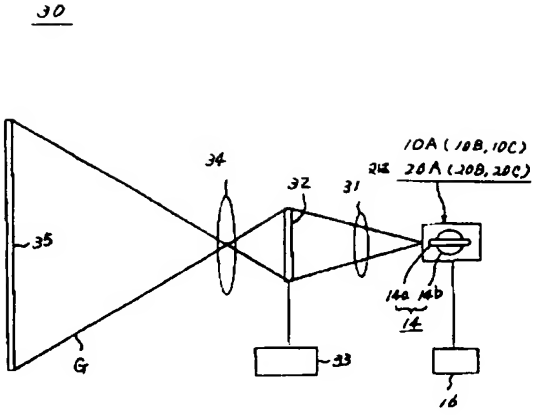
【図7】



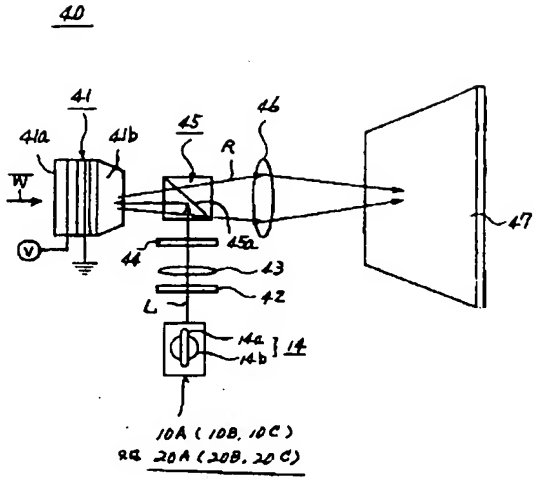
【図8】



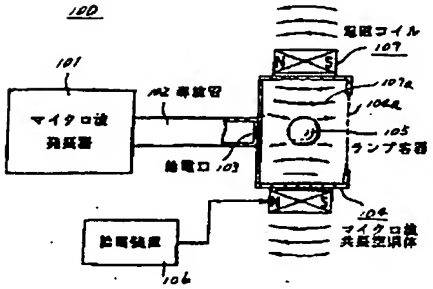
【図9】


30
34
32
31
10A (10B, 10C)
20A (20B, 20C)
35
G
33
14a 14b
14
16

【図10】


40
41
41a
41b
45
46
R
W
V
47
44
45a
43
42
L
14a
14b
14
10A (10B, 10C)
20A (20B, 20C)

【図11】


100
101
マイクロ波発振器
102 導波管
103
105
ランプ容器
106
107
107a
107b
マイクロ波共振空洞体